



Asset Management - The new challenge

“We believe the implementation of Asset Management tools will revolutionize the competitiveness of customers in much the same way that process optimization revolutionized the industry.”



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Asset Management is a term being used with increasing frequency, particularly among customers and suppliers in the process and power generation industries. Consequently, the term is also playing a major role in our thought processes and product planning at Bently Nevada. However, Asset Management concepts may not be familiar to many of you. This article illustrates what we mean by Asset Management and the role that Bently Nevada's products and services can play in it. To help, let's consider a fictional, but plausible, scenario...

Ron chewed on his pencil nervously and reviewed his spreadsheet once again. He'd been over the figures at least five times and each time the facts were the same...profits were down and maintenance costs were skyrocketing. Knowing he'd be sharing this information with corporate executives in a few days when he gave his annual report only heightened the sense of dread he was feeling.

Ron had been Plant Manager for a little over eight months, and this was to be his first opportunity to address corporate executives. Months before he had imagined this meeting — he anticipated presenting figures that showed continued improvement in plant profits. Ron thought this first meeting would create an excellent first impression, that he was a competent young

manager improving an already excellent plant. However, this was not promising to be the favorable meeting he had envisioned when he took the job. In fact, it was going to be just the opposite. Where had things gone wrong? It just didn't seem possible, considering the plant's recent history.

When he'd taken the job, it had seemed like the perfect opportunity. The previous three years had seen significant production increases and record-setting profits. The plant was the pride and joy of the corporation...a model of "best practice" for all the other plants in the company. In fact, Ron's predecessor, Cliff, had been so successful, that he'd been promoted to corporate headquarters, which opened the door for Ron to step in as plant manager.

Cliff's approach had been straightforward...he had championed a process control system upgrade that included a new Distributed Control System and advanced controls able to optimize the entire production process. Cliff had taken considerable risk due to the large investment in automation this required... millions of dollars in fact. But Cliff's studies had shown that the project would pay back in less than 12 months by significantly increasing the plant's ability to produce product closer to specifications and by running the process closer to design constraints. Cliff was confident that corporate approval for this upgrade would not result in disappointment.

As promised, the project was deemed a success with a payback of just ten months. The following two years were marked by maximized plant throughput, minimized energy costs per ton of product, and record-setting profits. Cliff's risk-taking had paid off handsomely, and the new title on his business card and corner office at corporate headquarters were constant reminders.

Such was the situation Ron found himself in now. He'd done nothing remarkably different than Cliff...in fact, he'd been "mentored" by Cliff personally and knew that he was running

the plant in much the same way as Cliff would himself. So why the sudden downturn? As Ron pondered the situation, he could not come up with anything he'd done that Cliff would not have done. It just didn't make sense... "I've done everything just the way Cliff would have done it...why me?"

And then it dawned on him...maybe that was just the problem. Was there something Cliff did...or didn't do...that was contributing to the seeming streak of bad luck during Ron's initial eight months on the job? Maybe it was something Cliff had done over the last three years that Ron was simply perpetuating and, as luck would have it, was only just now beginning to have repercussions.

Ron decided that if he was going to have to share bad news in the executive meeting he couldn't change that. But he could make sure he understood why things had gone wrong, and have a strong plan of action to correct the situation. Ron sent an e-mail to his Maintenance Manager, Operations Manager, and Process Engineer to meet in his office at 3:00 that afternoon. He was determined to get to the bottom of this after all...

We'll rejoin Ron's story in a moment. First, let's look a little more closely at this idea of process optimization. Figure 1 shows the desirable results (minimized energy cost, reduced product variability, increased throughput, lower emissions, etc.) we wish to optimize on the vertical axis and the process operating point along the horizontal axis. A real plant will have a highly complex relationship between the parameters to be minimized or maximized (i.e. optimized) and the operating points of the process...so complex, in fact, that it is impossible to model in 2- or even 3-dimensions. However, our simplified 2-dimensional diagram will convey the basic concepts.

Referring again to Figure 1 and our fictional character Cliff, let's consider what Cliff accomplished. Before the new control system, Cliff was operating his plant somewhere around the

point marked A. Cliff realized that if he could move the operation to point B, the decreased fuel costs, increased throughput, and other optimizations could be achieved without any changes to the physical plant assets, such as piping, vessels, and rotating machinery. This improvement in desirable results is shown by Δ in Figure 1. By simply controlling the process more intelligently, he could run the plant closer to optimum.

Thousands of process plants are currently performing, or have already performed, control system upgrades designed to help them optimize their processes. The paybacks for these upgrades are generally short (less than twelve months) and result in improved profits totaling millions of dollars per year.

With all the positive aspects of process optimization, you may be wondering where problems can occur. The answer lies not in what process optimization includes but rather what it often fails to include. Let's rejoin our story for the answers to this important question.

Ron's meeting had proven to be very fruitful. As he questioned his Maintenance Manager and Process Control Engineer he'd learned that part of Cliff's strategy was to push the process harder...right to nameplate ratings of the machinery in many cases, and even beyond. The optimization routines rarely included asset constraints with the possible exception of maximum rotational speeds allowed. The Maintenance Manager's problem was that the plant had never previously been pushed to these limits. A lack of proper instrumentation on the machinery made it impossible to determine the stress these process demands were having on the machines. No one really knew exactly where the machines could operate, relative to their nameplate ratings, without seriously degrading their useful life. This included not only the load on the machines, but process temperatures, pressures, flows, and other parameters that influenced the process fluids and materials as they moved through the machines.

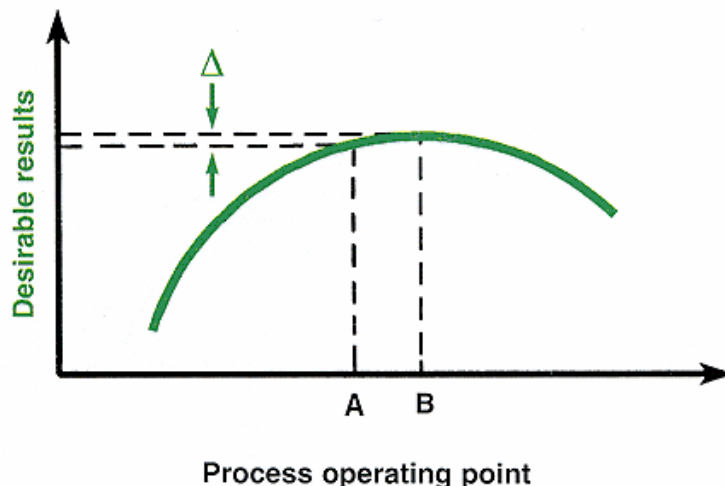


Figure 1

As Ron knew, a compressor failure during the last month had been a major contributor to the plant's poor economic performance. The failure couldn't have come at a worse time. Product prices were at an all-time high, but production had to be reduced to 50% of normal since the compressor was a critical part of the process stream and normally ran in parallel with another machine. At the time, the focus had been on getting the machine back online rather than performing a detailed study of why the failure occurred. However, Ron had instructed his Maintenance Manager to uncover the root cause of the failure, once the machine was back online and the process was again running at full capacity. Ron's Maintenance Manager had learned a great deal since the failure, and this meeting proved the perfect opportunity to share his findings.

When the Maintenance Manager had investigated the root cause of the failure, the symptoms clearly indicated a fluid instability in the compressor. Specifically, the process gas was exhibiting a whirl condition at the seal. A thorough analysis, along with input from the Operations Manager and the Process Engineer, yielded some other important findings. The Process Engineer verified that process constraints allowed for a $\pm 30\%$ flow variation in the compressor. However, at a particular flow condition, the seal whirl would occur. They agreed that, by simply avoiding this flow condition in the compressor, they could keep the whirl from occurring. Further, the presence of parallel compressors made it straightforward to share the load between the two machines while still allowing any desired total flow condition. The process was completely unaffected and there was no impact to the process optimization. There was, as they had learned the hard way, a tremendous impact to the asset life.

Another key piece of the puzzle also surfaced. According to the Operations Manager, operators currently had no vibration information on these machines at all. Although a predictive maintenance program was in effect, it consisted of monthly readings taken with a portable data collector. The result was that operations had no "real time" feedback that would indicate when the compressors were experiencing the whirl condition. In the unlikely event that data was gathered when the machine was experiencing this condition, it was virtually impossible to correlate this with process conditions, such as compressor flow. Thus, the key connection about process effects on the asset would have been overlooked.

Unfortunately, when the Maintenance Manager had suggested an online system several years ago, Cliff had elected to save costs by employing a portable data collection program for predictive maintenance on all machines, even large, critical compressor trains. Ron would need no urging in the future to see the value of online systems with operator feedback.

Together, Ron and his management team reached a significant conclusion. The plant optimization took into account only what was optimal for the process. No consideration had been given to the effect on the assets that resulted from changes in the process. Piping corrosion, machinery stress, and a host of other

factors that had a direct bearing on the life of the assets, were related to process conditions. As they had learned in the compressor situation, sometimes relatively minor process adjustments, with minimal impact to the process, could have major impacts on the machinery.

Ron and his team outlined some basic principles that would guide their actions in the future.

- Focusing only on the process did not necessarily result in optimal business decisions. Managing the business meant managing both the process and the assets that were used in the process. True optimization represents the optimum balance between asset management and process management.
- Operations were the "front line" in the minute-by-minute operations of the plant. The simple act of properly instrumenting the assets and providing this information to operators could help them identify process conditions that accelerated the wear on the assets or actually damaged them.
- Portable data collection could not adequately correlate process operating conditions with machinery conditions. Furthermore, the information could not be presented to operators in real time to help them understand the correlation and avoid certain operating regions.
- Process optimization routines could incorporate more accurate constraints on the process if more information on the machinery and other asset behavior were available. Intelligent trade-offs could be made between optimal process performance and optimal asset performance, to achieve optimal business decisions. In some cases, an optimal business decision might be to sacrifice a machine. However, it was imperative that managers be able to make such decisions knowledgeably; this required proper instrumentation to manage their assets.

Ron left the meeting with the conviction that asset management would become a part of his plant management methodology, and that asset management could have avoided the problems that plagued his first eight months at the plant. He had a strong hunch that the compressor wasn't the only asset that was being affected by process changes and gave his team one month to investigate other assets, such as piping and vessels, and determine if similar accelerated wear was occurring elsewhere in the plant. Ron was willing to bet that they'd find dozens of opportunities to apply asset management principles.

Although Ron couldn't change the figures he'd be presenting to executive management in a few days, he was confident he had the answer he'd been looking for...what went wrong and how he could correct it. In fact, Ron now felt he was in a position to actually improve on the results Cliff had achieved. Perhaps he'd impress executive management in spite of the bad news...Ron would show that he could not only learn from mistakes but actually find opportunities in them.

Many of Bently Nevada's customers are coming to the same conclusions as our fictional friend Ron. Most of the significant

gains available through better process control have already been made, and the discipline of process optimization is reasonably understood. Further gains will be made not so much by better control of the process, but by a better understanding of how the process affects plant assets and by proper asset management programs. Figure 2 shows how the proper use of both process and asset information can yield optimal business decisions.

With the process operating at point A, process revenues are maximized. However, the maintenance costs are also quite high. By operating the process at point B instead, there is very little change Δ_{PR} in the process revenue. The change Δ_{MC} in maintenance costs is significant, though. When making an optimal business decision, it is this difference between process revenue and maintenance costs that should be maximized. This would dictate operation at point B in Figure 2.

Bently Nevada is excited about the role our products will increasingly play in an effective Asset Management program, because a significant part of most plant's assets are their rotating machines. Bently Nevada is not just talking about Asset Management...we are delivering products *today* that you can effectively implement in your asset management program. For example, our Trendmaster® 2000 for Windows and Data Manager® 2000 for Windows NT software provide NetDDE™ and Modicon Modbus® communication protocol capabilities. These effectively "open" our product, so data can be shared with process control systems, data historians, plant optimization software, and other relevant software applications.

Much of the value to be gained is in simply exposing operations to the effects that process changes are incurring in the machinery. These communications capabilities make it much easier to integrate our products with the other control and automation products you use in your plants, particularly the operator interface products. With the trend toward the use of Microsoft's Windows NT operating system in even large-scale DCS systems, it is now possible to actually run Bently Nevada

software on operator consoles. For the more traditional UNIX and VMS operating system environments, these products are X-Windows compatible, which also provides a cost-effective means to get asset information in front of operators.

We are already delivering the right information to the right people with our Engineer Assist™ software. It goes beyond simply presenting data to operators and machinery specialists and actually provides written reports on the nature, severity, and, most importantly, root cause of machinery problems. It is capable of using process information, such as flows, pressures, and temperatures, along with the machinery data provided by Bently Nevada's online software, such as TDM2, DDM2, and Data Manager® 2000.

Our challenge in the near future involves presenting the right information to others in the plant besides operators and machinery specialists. These include instrument maintenance personnel, plant management, process control personnel, and machinery OEMs. Another equally important challenge is to ensure the information we provide to various people is *actionable*. For example, actionable information for an operator might take the form of an advisory right on their process control system screen that tells them what is happening, why it is happening, and perhaps most importantly, what they can do to make the situation better *immediately*. We are already leading the industry with the capabilities in our systems today. However, you can expect even more exciting developments from Bently Nevada in the future as we expand the capabilities of our systems to address asset management issues.

We believe the implementation of Asset Management tools will revolutionize the competitiveness of customers in much the same way that process optimization revolutionized the industry. You can depend on Bently Nevada to demonstrate leadership in this important area through our cooperative efforts with leading process control suppliers, our comprehensive knowledge of rotating machinery, and our continued product innovation. ■

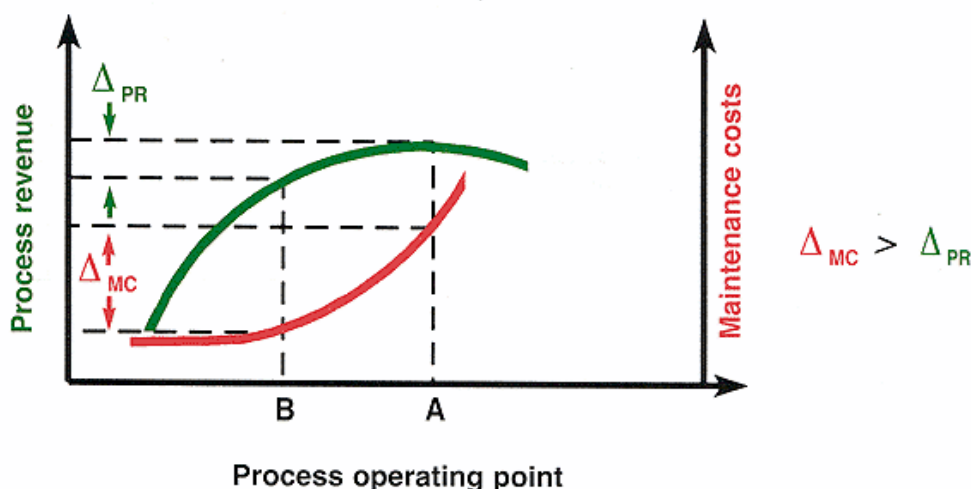


Figure 2